Space Weather Technical Forecast

Issued on Friday, 19 November 2021 at 12:41 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor geomagnetic storms this weekend.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the last 24 hours, with no significant X-ray flare activity observed at GOES 16. There are two active sunspot regions on the visible disc: AR2896 and AR2897, which are both small and stable unipolar Hsx/Alpha regions located in the eastern hemisphere.

No Earth-directed Coronal Mass Ejections (CMEs) have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind parameters indicate a gradual exit from the high speed stream of coronal hole 19. The solar wind speed, as measured by DSCOVR and ACE at L1, started the period at elevated levels, around 550 km/s, then gradually declined by the end of the period to slightly elevated, around 450 km/s. The solar wind density remained at average levels. The IMF Bt was weak and very stable between 3-4nT, with only weak deflections of +3/-2 nT in the Bz. The phi angle was entirely negative (towards the Sun). Therefore, despite the strength of the solar wind, geomagnetic activity was Quiet (Kp 0-2) throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained at Background levels.

The high energy electron flux (greater than 2 MeV) was predominantly at Moderate levels, peaking at 365 pfu at 18/1940 UTC. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), with a steady trend, reaching 8.69e6 integrated pfu at 19/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Very Low, with a Slight Chance of C-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs in the current forecast. The coronal hole forecast comprises of a continuing slow decline from the current HSS from CH19/-; before the next high speed stream arrives, this time from CH20/- during the second half of day 2. Geomagnetic activity is expected to be Quiet (Kp 0-2) on day 1 and the first half of day 2 (20th Nov), before increasing predominantly Unsettled to Active (Kp 3-4) during the second half of day 2, with a chance of G1/Minor (Kp 5) geomagnetic storms. A similar theme is expected days 3 to 4 as CH20/- continues to have effect at Earth, but with a likely declining risk of G1/Minor geomagnetic storms later in the period.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels.

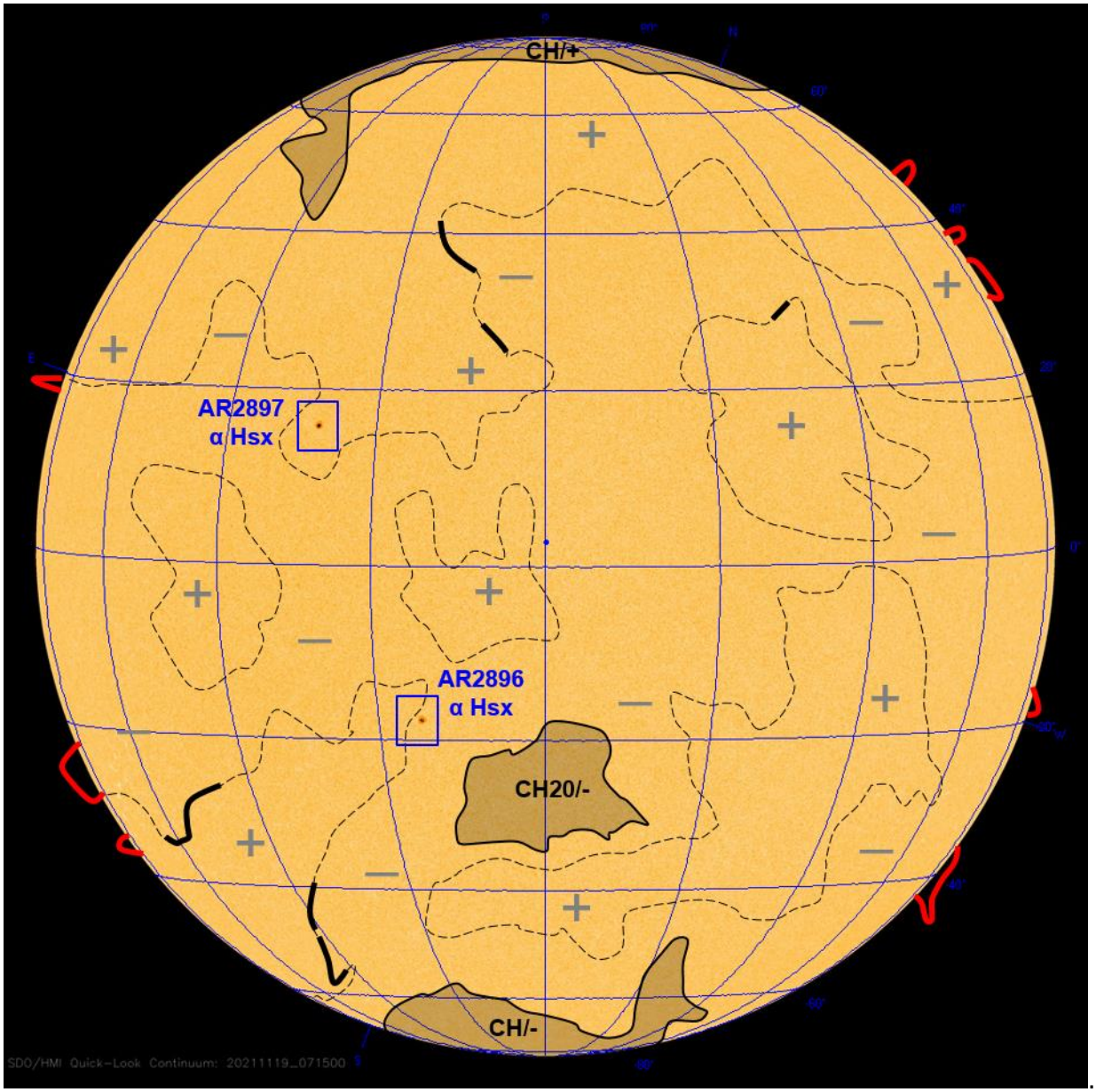
The high energy electron flux (greater than 2 MeV) has not reached High (1000 pfu) levels, despite days of strong or elevated solar winds. There is a risk of the high energy electron flux exceeding the High threshold on days 1 or 2 (19th or 20th), then declining later day 2 into day 3 (20th/21st). Flux levels will then reduce once again on the onset of CH20/- but is likely to breach the High threshold after the next HSS arrives, possibly during day 4 (22nd) or later. The

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2021. All Rights Reserved.

corresponding fluence is likely to have an increasing trend, whilst remaining below the Active (1e8 integrated flux).

Figure 1. Solar Analysis Valid 19/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2021. All Rights Reserved.

Geomagnetic Storms:

There are no Earth-directed CMEs that feature in the current forecast.

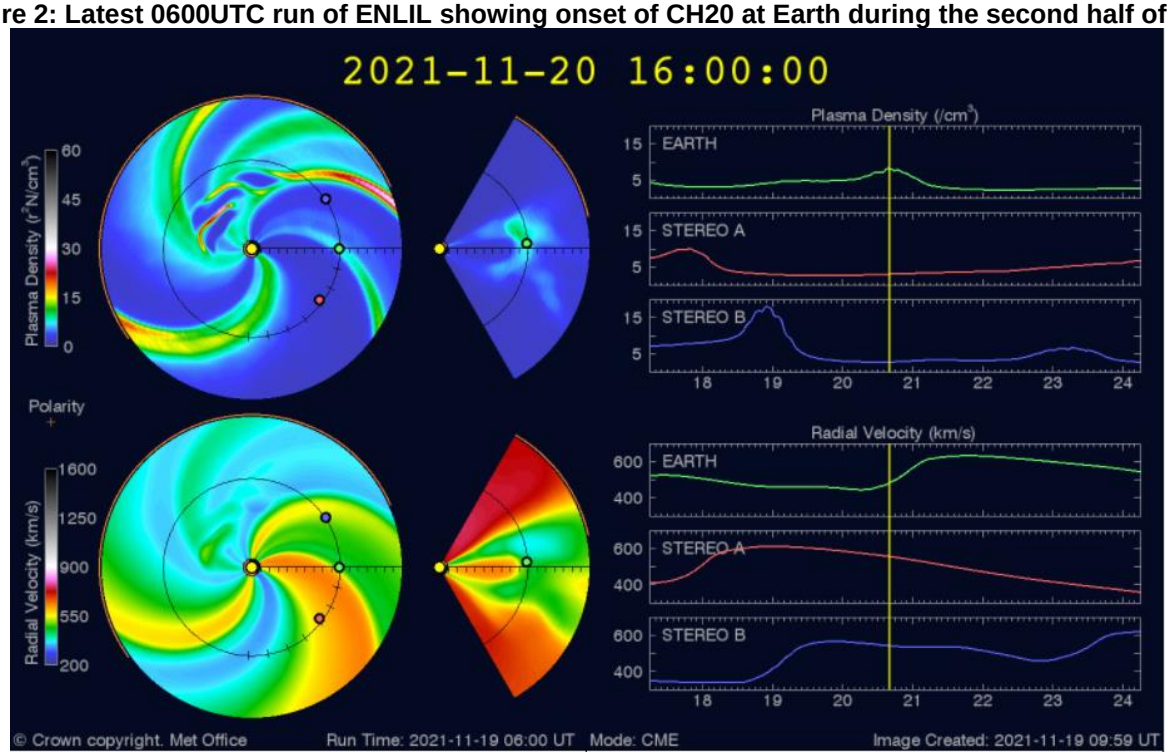
The coronal hole forecast comprises of a continuing slow decline from the current HSS from CH19; before the next high speed stream arrives, this time from CH20.

Currently, using a compromise between STEREO A measurements and Enlil, an onset of the HSS from CH20 is expected during the second half UTC of day 1 (20th). Looking at the STEREO A data, strong speeds with speeds between 600-750km/s are possible. Therefore, despite approaching the semi-annual minimum in coronal hole potency, there remains a Chance of G1, possibly peaking as the feature matures into day 3 (21st).

Geomagnetic activity is expected to be Quiet (Kp 0-2) today (19th) and early tomorrow (20th), before increasing predominantly Unsettled to Active (Kp 3-4) later tomorrow, with a chance of G1/Minor (Kp 5) geomagnetic storms thereafter.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	50	50	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Latest 0600UTC run of ENLIL showing onset of CH20 at Earth during the second half of 20th.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2021. All Rights Reserved.

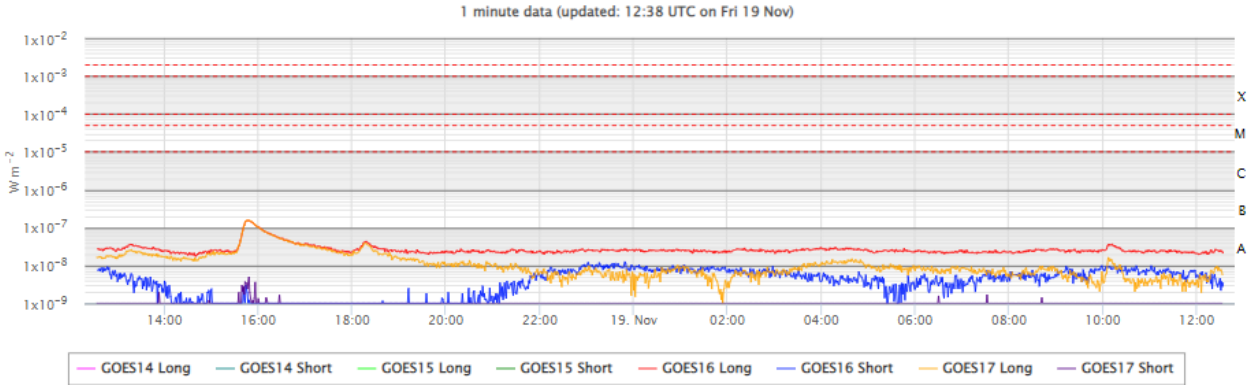
Radio Blackouts - X-Ray Flares:

There are currently two active sunspot regions on the visible disc; AR2896 and AR2897. Both are simple, stable and unipolar spots.

Neither region will rotate off the visible disc during the forecast period. There are various returning Carrington locations lying near or on the eastern limb at present. Despite this, STEREO A EUVI imagery does not indicate that any significant regions will arrive from the farside through the period. Therefore Very Low solar activity is forecast, with a slight chance (10%) of C-class flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Xray trace past 24 hours.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2021. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at Background levels during the previous 24 hours, and is currently forecast to remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2021. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

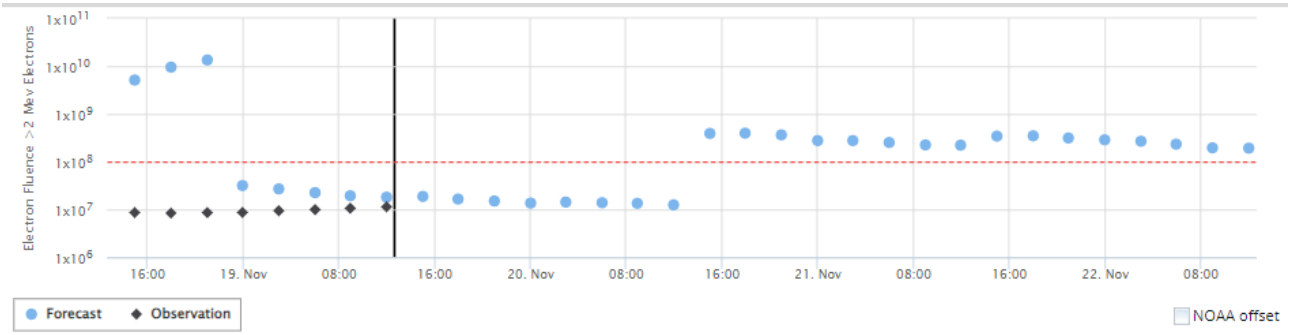
The high energy electron flux (greater than 2 MeV) has not reached High (1000 pfu) levels under the influence of the HSS from CH19, despite days of strong or elevated solar winds. As the solar wind speeds continue to decrease further on day 1, there is a risk of flux levels breaching the high threshold later on day 1 (19th) and into early day 2 (20th). The onset of CH20/- later on day 2 will then likely suppress flux levels below the active threshold once again before we begin to exit the HSS from CH20/- later on day 4 (22nd) or beyond.

The corresponding fluence is likely to have an increasing trend, whilst remaining below the Active (1e8 integrated flux), perhaps with a further increase toward the end of the period.

The Met Office REFM model shows the fluence remaining below the Active threshold during day 1 (19th), but then increases the fluence to above Active for days 2 and 3. This is considered to be initially good guidance, before then declining in usefulness due to it's lack of recognition of CH20/- during day 2 (20th) and beyond.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	20	20	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

Figure 4: Latest REFM fluence forecast and observations, showing flat trend currently.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2021. All Rights Reserved.